

Metal halide perovskite solar cells: stability issue and lead-free devices

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Perovskite solar cells (PSCs) emerging as a promising photovoltaic technology with high efficiency and low manufacturing cost have attracted the attention from all over the world. Stability issues are the major bottleneck for their commercialization. The weak chemical interactions of metal halide perovskite induce the irreversible decomposition of PSCs under moisture, light, and thermal stress. In this talk, I will present our recent works on improving the long-term stability of PSCs based on efficient defect passivation, introducing aprotic sulfonium buffer layer, and developing the graphene-like self-assembled monolayer hole-selective contact.^[1-5] Based on these strategies, we recently reported a record operational lifetime for both small-sized solar cell and large-area solar module. We also combined the in situ mass spectroscopy technique and theoretical simulations to clarify the light-induced degradation mechanism of the perovskite film under operational condition. Furthermore, we extended our stability studies to the eco-friendly tin perovskite solar cells towards the application of indoor photovoltaics and wearable electronic devices, which includes suppressing the Sn²⁺ oxidation by antioxidant additives, and developing new device structure to improve thermal stability and minimize charge recombination loss.^[6-10] The results provide a fundamental basis to achieve long-term stable PSCs towards commercialization and industrial production.^[11]

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